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CLIMATE CHANGE FUEL CELL PROGRAM  
New Program Boosts Fuel Cell Industry

Project Benefits

Fuel cells are similar to batteries in that they both produce a DC current by using an electrochemical process. Two electrodes, an anode and a cathode, are separated by an electrolyte.

Like batteries, fuel cells are combined into groups, called stacks, to obtain a usable voltage and power output.

Unlike batteries, fuel cells do not “run down” because they receive their fuel source from outside the cells. Instead, they convert the energy from a hydrogen-rich fuel directly into electricity. They will continue to operate as long as they are supplied with fuel and air.

Fuel cells emit almost none of the sulfur and nitrogen compounds released by conventional generating methods, and can utilize a wide variety of hydrogen-rich fuels: natural gas, coal-derived gas, landfill gas, biogas, or alcohols.

Three types of fuel cells are targeted for stationary power generation:

**Phosphoric Acid Fuel Cells (PAFC)** are the most mature commercially available fuel cell technology. They operate at about 200°C (400°F), and their electrical efficiency can exceed 40 percent (LHV). With the use of by-product heat, total efficiency can reach 80 percent.

**Molten Carbonate Fuel Cells (MCFC)** are now being tested in full-scale demonstration plants. They offer higher fuel-to-electricity efficiencies (approaching 60 percent LHV), and operate at higher temperatures (about 650°C, or 1200°F). When the by-product heat is used, total efficiencies can approach 85 percent.

**Solid Oxide Fuel Cells (SOFC)** are currently being tested in a 100-kilowatt plant. They offer the stability and reliability of all-solid-state ceramic construction. Their high-temperature operation (up to 1000°C, or 1800°F) allows more flexibility in the choice of fuels. Like MCFC, SOFC approach 60 percent electrical efficiency LHV, and 85 percent total efficiency.

Cost Profile

(Dollars in Millions)

	FY95	FY96	FY97	FY98	FY99
Department of Defense*	\$8.4	—	—	—	—
Private Sector Partners	—	\$4.1	\$21.2	\$8.7	\$0.9

\* Appropriated Funding

Key Milestones

FY95	FY96	FY97	FY98	FY99	FY00	FY01
Funding	Solicitation	Acceptance Testing			Operation Testing	
Funding authorized	Solicitation completed	Acceptance testing completed			Operations testing completed	

PROJECT  
facts

DEPARTMENT OF ENERGY  
OFFICE OF FOSSIL ENERGY  
FEDERAL ENERGY TECHNOLOGY CENTER

NATURAL gas  
RESEARCH

NG001.0897M

CLIMATE CHANGE FUEL CELL PROGRAM  
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Project Description

Fuel cells have emerged in the last decade as one of the most promising new technologies for meeting the Nation’s energy needs well into the 21st century. Unlike power plants that use conventional technologies, fuel cell plants that generate electricity and usable heat can be built in a wide range of sizes—from 200-kilowatt units suitable for powering commercial buildings, to 100-megawatt plants that can add baseload capacity to utility power plants.

The Climate Change Fuel Cell Program is a joint effort of the U.S. Departments of Defense (DoD) and Energy (DOE) that was authorized by Congress in the fiscal year 1995 Defense appropriations bill. The DOE Federal Energy Technology Center (FETC) is implementing and managing the program, providing financial assistance to buyers of fuel cells who are energy-service providers, utilities, or end users.

Fuel cells offer extremely high efficiency in the production of electricity, yet very low pollutant emissions. The objectives of the Program are to reduce greenhouse emissions, accelerate fuel cell commercialization, and satisfy DoD goals for the environment and U.S. economy.

Congress authorized additional funding for fiscal years 1996 and 1997 through the Defense appropriations bill. It is expected an additional \$14 million will be awarded through this program.

Program Goal

Thirty-three awards were made to utility, end user, and energy service providers for utility, commercial, or industrial use of fuel cells in the U.S. and abroad. Most of the projects are for 200-kilowatt fuel-cell installations, but several are for 400-, 600-, or 800-kilowatt operations. All grantees are purchasing fuel cells from the ONSI Corporation of South Windsor, Connecticut. ONSI is the marketing subsidiary of International Fuel Cells.

The 33 grantees are purchasing a total of 42 ONSI 200-kilowatt units, to be used as single units or multiple arrays of the 200-kilowatt module.

The program is a key element of the Federal Administration’s Climate Change Action Plan, which is an effort to curb emissions of greenhouse gases in part through the development of environmentally clean energy technologies. The intent of the program is to satisfy DoD goals for the environment, readiness, and economy through activities that would stimulate end-user applications. This would stimulate a major expansion of fuel-cell manufacturing capability in the U.S. and, in turn, bring mass-produced fuel cells into a cost range that is competitive with more traditional sources.

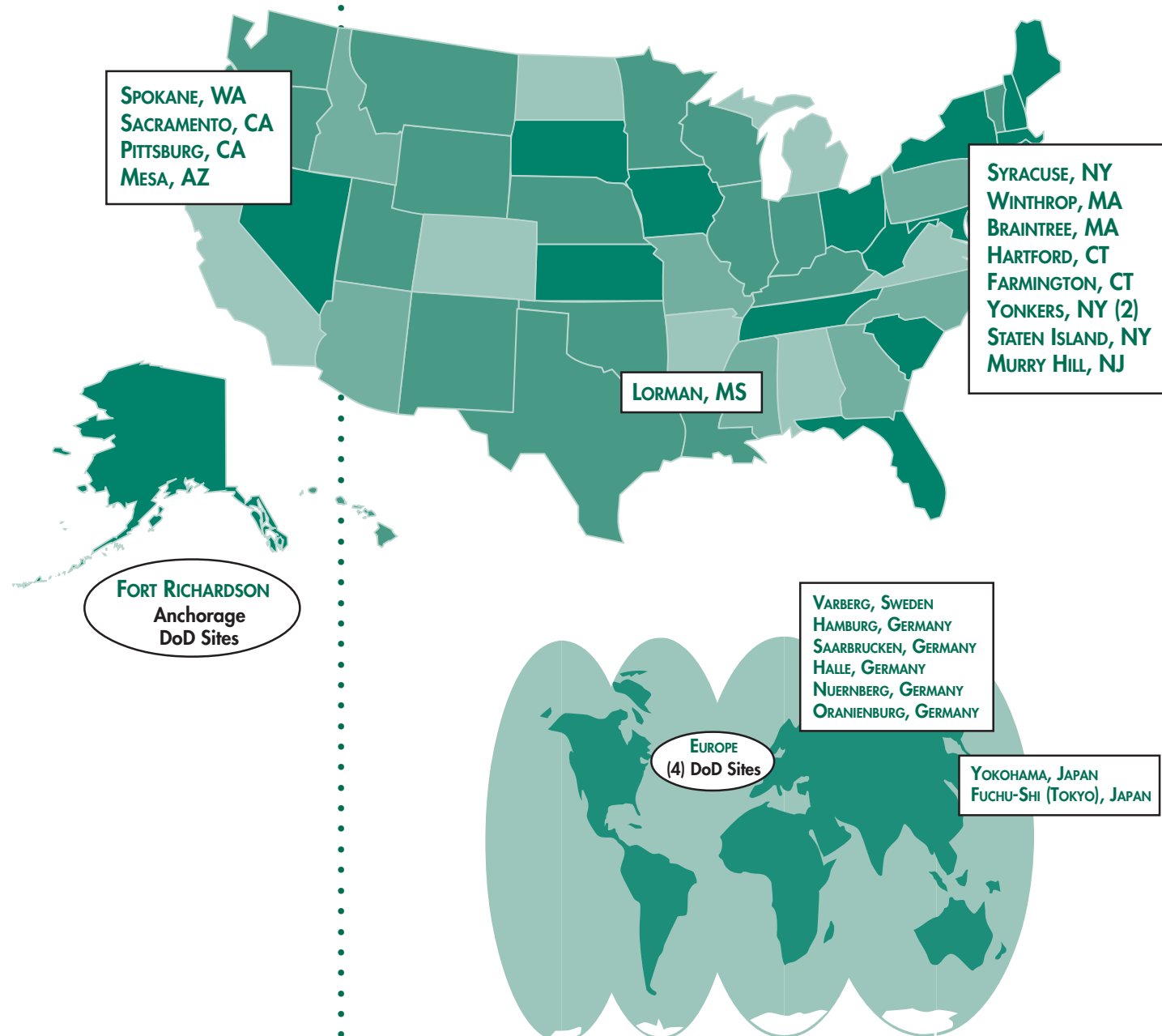
Since fuel cells generate electricity electrochemically, rather than mechanically, they are more efficient over a wider load factor and can cut greenhouse gases by over 50 percent.



### PROGRAM FACTS

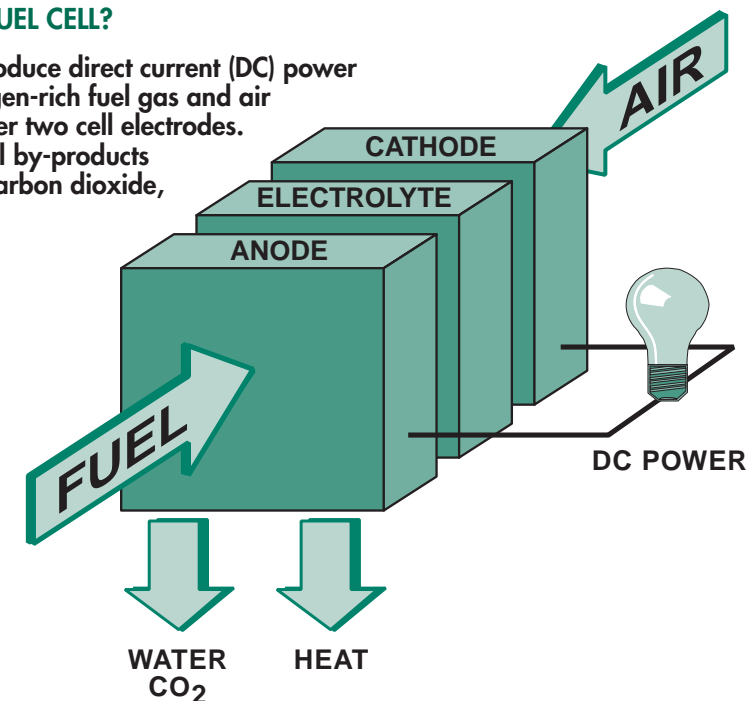
ACCEPTANCE TEST	TYPE OF APPLICANT	TYPE OF USE
1996 = 5	Utility = 12	Utility = 6
1997 = 24	End User = 10	Industrial = 8
1998 = 4	Energy Service = 7	Commercial = 18
	Mixed (End User + Utility or Utility + Electric) = 4	Mixed (Utility/Commercial) = 1

### FUEL CELLS IN THE U.S. AND ABROAD



### WHAT IS A FUEL CELL?

Fuel cells produce direct current (DC) power from hydrogen-rich fuel gas and air that flow over two cell electrodes. The principal by-products are water, carbon dioxide, and heat.



### SPECIFIC USES:

- Heating District Building/Network
- Hotel
- Laboratory/Processing Plant
- Manufacturer
- Medical Facility
- Military Housing/Facility
- Office Building
- University/School
- Wastewater Treatment

### UNIQUE FEATURES:

- Transportable (1)
- Premium Power (2)
- Anaerobic Digester (2)
- Anaerobic Gas (1)
- Propane (1)
- Landfill Gas (1)
- Hydrogen Fueled (1)

### WHY CHOOSE THE ONSI FUEL CELL?

The ONSI PC25™ is a phosphoric acid fuel (PAFC). PAFC technology is already a commercial reality. ONSI's 200-kW modular unit was first installed in 1992 and since then, over 100 units have been sold worldwide.